

1. There is no reaction because the equilibrium constant is too small.

$$2. K = e^{\frac{-\Delta G}{RT}} = e^{\frac{0}{RT}} = e^0 = 1$$

3. a. CaF_2 will have the same solubility in water and in NaCl

b. CaF_2 will be less soluble in CaCl_2 than in water

c. CaF_2 will have the same solubility in water and in KBr

d. CaF_2 will be less soluble in NaF than in water

4. a. RbF is soluble in water

b. TiCO_3 is mostly insoluble in water

c. $(\text{NH}_4)_2\text{S}$ is soluble in water

d. CaCl_2 is soluble in water

5. The student should mix the solution with NH_4OH

$$6. \Delta G = - (R(T)(\ln(K)))$$

$$= - (8.314 \frac{\text{J}}{\text{mole}(K)}) (288 \text{ K} (\ln(1.12 \times 10^{-2})))$$

$$= 1.08 \times 10^4 \frac{\text{J}}{\text{mole}}$$

7. 'C: 25 solubility Ag_2S : 1.0×10^{-12}



$$= 1.0 \times 10^{-12} = (\text{Ag}^+(aq))(\text{S}^{2-}(aq))$$

$$1.0 \times 10^{-12} = (2x)^2(x) = \sqrt[3]{1.0 \times 10^{-12}} = \sqrt[3]{1 \times 10^{-12}} = 1 \times 10^{-4}$$

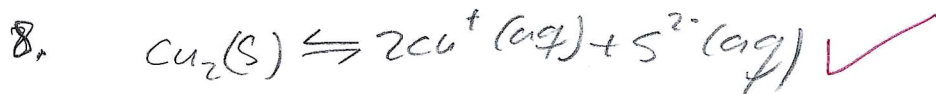
$$\Rightarrow 6.3 \times 10^{-5} = x$$

Silver ion = $2x$

$$= 2(6.3 \times 10^{-5})$$

$$(\text{Ag}^+(aq)) = 1.3 \times 10^{-4} \text{ M}$$

$$\frac{25}{25} = 100\%$$



Solubility equation: $K_{sp} = [\text{Cu}^+(\text{aq})]^2 [\text{S}^{2-}(\text{aq})]$

$$K_{sp} = (1.3 \times 10^{-18})(6.7 \times 10^{-17})$$

$$= 1.1 \times 10^{-34}$$
 ✓



$$K_{sp} = (\text{Ca}^{2+}(\text{aq}))^3 (\text{PO}_4^{3-}(\text{aq}))^2$$

$$1.10 \times 10^{-25} = (3x)^3 (0.50)^2$$
 ✓

$$1.10 \times 10^{-25} = (27x^3)(0.25)$$

$$\frac{1.10 \times 10^{-25}}{6.75} = \frac{6.75x^3}{6.75} \quad 3\sqrt{x^3} = \sqrt[3]{1.629 \times 10^{-26}}$$

$$x = 2.5 \times 10^{-9}$$
 ✓

$$[\text{Ca}^{2+}] = 3(2.5 \times 10^{-9}) = 7.5 \times 10^{-9}$$
 ✓



$$K_{sp} = (\text{Ca}^{2+})(\text{SO}_4^{2-})$$

$$2.4 \times 10^{-5} = x(0.0010 + x)$$
 ✓

$$2.4 \times 10^{-5} = x(x + 0.0010)$$

$$2.4 \times 10^{-5} = x^2 + 0.0010x$$

$$\begin{array}{r} 2.4 \times 10^{-5} \\ -2.4 \times 10^{-5} \end{array} \quad \begin{array}{r} -2.4 \times 10^{-5} \\ -2.4 \times 10^{-5} \end{array}$$

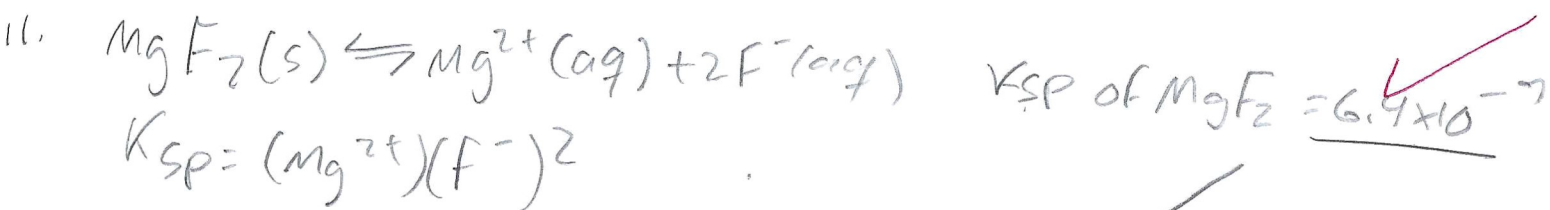
$$0 = x^2 + 0.0010x - 2.4 \times 10^{-5}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-0.0010 \pm \sqrt{(0.0010)^2 - 4(1)(-2.4 \times 10^{-5})}}{2(1)}$$

$$= \frac{-0.0010 \pm \sqrt{0.000001 + 0.0000096}}{2} = \frac{-0.0010 \pm 0.00098}{2}$$

$$x = 0.0044$$
 ✓

$$[\text{Ca}^{2+}] = 0.0044 \text{ M}$$
 ✓

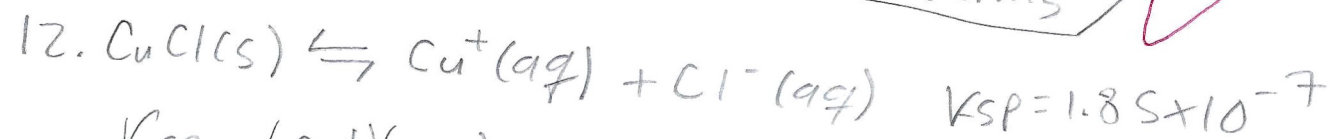


$$K_{sp} = (\text{Mg}^{2+})(\text{F}^-)^2$$

$$K_{sp} = (0.023)(0.0850)^2$$

$$= 5.8 \times 10^{-7}$$
 ✓

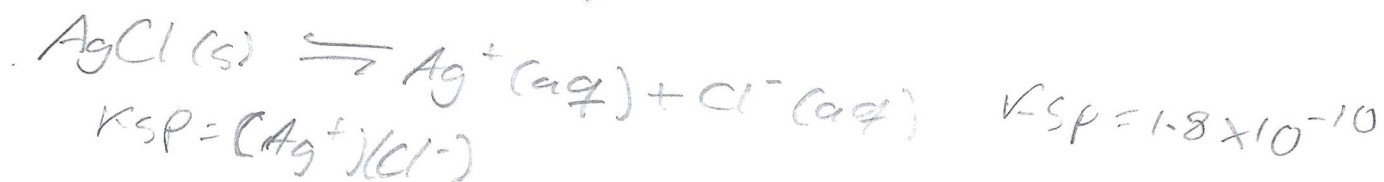
precipitate forms ✓



$$K_{sp} = (\text{Cu}^+)(\text{Cl}^-)$$

$$\frac{0.10(\text{Cl}^-)}{0.10} > \frac{1.85 \times 10^{-7}}{0.10}$$

$$\text{Cl}^- > 1.85 \times 10^{-6}$$
 ✓



$$K_{sp} = (\text{Ag}^+)(\text{Cl}^-)$$

$$\frac{0.10(\text{Cl}^-)}{0.10} > \frac{1.8 \times 10^{-10}}{0.10}$$

$$\text{Cl}^- > 1.8 \times 10^{-9}$$
 ✓

Therefore, AgCl will be the first precipitate. ✓